CAAM 336

DIFFERENTIAL EQUATIONS IN SCIENCE AND ENGINEERING

Fall 2015 · Rice University

Credit:	3 Credit Hours
Lecture:	MWF 1:00-1:50, Duncan Hall 1070
Web Site:	http://www.caam.rice.edu/~caam336
Instructors:	Travis Thompson (tthompson@rice.edu), Duncan Hall 3023, (713) 348-6113 Office hours : Thursday 4:00 p.m. - 5:00 p.m. or by appointment
Teaching Assistant:	Emily Hendryx (emily.hendryx@rice.edu), Duncan Hall Rm 2108 Office hour: Wednesday, 5p.m. - 6p.m. Duncan Hall Rm 2108
Recitation:	Tuesday evenings, 7p.m. - 9p.m. Duncan Hall. Room TBD

Absence Policy: Due to the size of the course attendence will not be strictly enforced. However, students who desire to do well in the course are strongly advised to attend lecture at all times. If you cannot attend a lecture, please find another student in the class who can communicate what material was covered. **Failure to attend a scheduled exam may result in you being given a score of zero for that exam**.

Text: The content of this course is based on material from:
Mark S. Gockenbach, *Partial Differential Equations: Analytical and Numerical Methods*, SIAM, Philadelphia, 2011.

Grade Policy: Homework will account for 40% of the final grade and three scheduled exams will account for the remaining 60%. The last exam will be a scheduled exam which will take place during the final exam period. Failure to attend a scheduled exam may result in a score of zero for that exam.

Matlab: Most homework questions will require some MATLAB programming. Any MATLAB codes that you write for the homework must be printed out and attached to the corresponding homework in order to receive credit. For assistance with parts of the homework requiring MATLAB, please consult the class website for additional materials.

Honor Code: It is an honor code violation to turn in code or solutions which have, in all or in part, been copied from another student. It is also an honor code violation to consult solutions to the homework or exams from previous sections of this class.

Homework: Problem sets will be assigned roughly once a week, due at 4pm on the specified date. Mathematically rigorous solutions are expected; clear explanation is important. **You are strongly encouraged to collaborate on the problem sets**. You must produce your own, independent write-up of the work utilizing your own wording. **Transcribed solutions and copied MATLAB code are both unacceptable**. *You may not consult solutions from previous sections of this class.*

Late Policy: You may turn in **one** problem set by 4pm on the next class day without penalty. Subsequent late assignments will be penalized 20% each. Homework will not be accepted more than one class period late. In exceptional circumstances, contact the instructor as soon as possible We adhere to Student Health's No Note policy.

Re-grade Policy: If your work has been graded incorrectly, you may submit a re-grade request. Clearly explain the perceived error on a separate sheet of paper, staple it to the front of your graded paper, and give it to the instructor.

Any student with a disability requiring accommodation in this course is encouraged to contact the instructor during the first week of class, and also to contact Disability Support Services in the Allen Center. (713) 348-5841

Prerequisites:	CAAM 210 (Introduction to Engineering Computation) and MATH 212 (Multivariable Calculus), or permission of the instructor. Less formally: you should be able to write elementary MATLAB programs, and be comfortable with vector calculus and basic vector and matrix operations. Basic knowledge of ordinary differential equations will be advantageous.
Course Objectives:	CAAM 336 students learn to identify partial differential equations and solve some canonical cases using both analytical and computational techniques.
Course Outcomes:	Upon completing this course, students should be able to: 1) explain the concept and computation of a best approximation from a subspace; 2) identify linear operators and compute their spectra in basic cases; 3) apply these concepts to obtain exact series solutions to differential equations; 4) approximate solutions with the finite difference and finite element methods; 5) develop codes in MATLAB to compute and visualize numerical solutions

CAAM 336 · Manifesto and Outline

Differential equations form the heart of applied mathematics: the language of differential equations has been employed, since the 17^{th} century, to describe phenomena in fields varying from from the physical sciences and engineering to biology, and finance. In practice these equations can be difficult to solve; even those that describe fundamental events and systems we encounter in our every day lives.

In the last hundred years computing devices have come to the fore as a primary means of exploring our world; they are, in a sense, the great scientific tool of the current age. Moreover, in the last seventy years, computer scientists, engineers, and mathematicians have been studying techniques to approximate the solution to problems written in the language of differential equations using these devices.

This course represents the intersection of these disciplines. As a student in CAAM 336 you will learn some of the basics of the language of partial differential equations, you will see how they arise from physical phenomena, and you will gain a brief introduction to some of the tools for their solution. Some of these tools will be analytic in nature and some will be computational. This course will also focus on using computing software, amenable to the novice investigator, to approximate the solutions to partial differential equations, visualize their results, and to understand some of the limits of computational inquiry.

A general, non-exhaustive, overview of the course topic objectives are as follows: Vector spaces, Differential equations from a viewpoint of linear operators, the Heat Equation, the Wave Equation, Fourier Series, and numerical solutions via the finite difference and finite element methods.

Notice of Disclaimer:
The information contained in the course syllabus, other than the absence policy, may be subject to change given reasonable advance notice as deemed appropriate by the instructor.